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TWO NEW MYRMECOPHILOUS MITES OF THE GENUS ANTENNOPHORUS.[1]

By William Morton Wheeler.

The mites of the genus *Antennophorus*, owing to their extraordinary parasitic relations with various ants of the genus *Lasius*, have been assiduously studied in Europe by Janet, Wasmann, Karawaiew and Berlese, but up to the present time our North American species have remained unknown. A few North and South American mites, to be sure, have been described as species of *Antennophorus*, but they are now known either to belong to different genera or to have a very doubtful taxonomic status. Several years ago I found on some workers of *Lasius umbratus* Nyl. var. *aphidicola* Walsh, at Colebrook, Connecticut, a large, active mite, which Wasmann described as *Antennophorus wheeleri*.[2] Berlese [3] however has recently placed this species in a distinct genus, *Echinomegistus*, which also includes, though in a separate subgenus (*Antennomegistus*), a Brazilian mite which he formerly described as *Antennophorus caputcarabi*. In another paper Wasmann described under the name *A. barbatus* [4] a large mite which was found attached to a common legionary ant, *Eciton praedator*, in the state of Santa Catharina, Brazil, but it is by no means clear from his brief description, in which he dwells only on a few superficial characters, that the specimen is a true *Antennophorus*. Berlese has shown that still another species, *A. raffrayi* Wasmann, found in nests of *Plagiolepis custodiens* at the Cape of Good Hope, belongs to a peculiar genus which he calls *Physalozercon*. I am inclined to believe from the taxonomic changes which have overtaken

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 12.

[2] Zur Kenntnis der myrmecophilen Antennophorus und anderer auf Ameisen reitender Acarinen. *Zool. Anzeig.*, XXV, 1902, 72.

[3] Illustrazione Iconografica degli Acari Mirmecofili. *Redia*, I, 1904, p. 398.

[4] Neue Dorylinengäste aus dem neotropischen und dem aethiopischen Faunengebiet. *Zool. Jahrb. Abth. f. Syst.* XIV, 1900, p. 41.

all of these species except *barbatus*, and the insufficient evidence of this really being an *Antennophorus*, that the genus will prove to be peculiar to the north temperate zone and to comprise species which are always parasitic on ants of the genus *Lasius*. As this group of ants is abundantly represented in North America, we should expect the parasitic genus to have a like representation. This turns out to be the case, since during the spring of 1909 I succeeded in finding near the Arnold Arboretum at Forest Hills, Boston, Massachusetts, two typical *Antennophori* allied to the four known European species (*uhlmanni* Haller, *foreli* Wasmann, *pubescens* Wasmann and *grandis* Berlese). The American forms occurred, as was to be expected, on workers of the common yellow ants belonging both to the typical genus *Lasius* and to the subgenus *Acanthomyops*, which is peculiar to the nearctic fauna. Only one of the mites, the one I call *A. donisthorpei*, was seen in a living condition. It was perched on the gula, or lower surface of the ant's head, actively waving its long, antenniform forelegs about in the manner so often described for the various European species. There can be little doubt, therefore, that, like its transatlantic cousins, it titillates its host or any ants within reach of its appendages and induces them to feed it with droplets of regurgitated food. Janet[1] has shown that when only a single *A. pubescens* is present on the European *L. mixtus* it clings to the ventral surface of the ant's head, with its forelegs directed towards the ant's mouth-parts. When two are present, there is one on each side of the head or one on each side of the gaster; in the former case the antenniform appendages are directed towards the anterior, in the latter towards the posterior end of the ant's body. When there are three mites, one attaches itself to the gula and the two others to the sides of the gaster. Four place themselves in pairs on the sides of the head and gaster. If six are present, which rarely happens, four are arranged in pairs on the sides of the head and gaster, while of the two remaining individuals, one attaches itself to the gula, the other to the mid-dorsal surface of the gaster. Janet believes that these symmetrical arrangements are for the purpose of balancing the burden and thus making it easier for the ants to carry.

As the species of Lasius on which both the European and North American *Antennophori* occur, are specially devoted to attending root-

[1] Sur le Lasius mixtus, L'Antennophorus uhlmanni, etc. Études sur les Fourmis, les Guêpes et les Abeilles Note 13. Limoges 1897, 62 pp., 16 figs.

aphids and root-coccids and may be said to live in permanent symbiosis with these Homoptera, we can understand why the mites occur only on these particular ants. The plant-lice and mealy-bugs pump the juices out of the plants and pass on to the soliciting ants the unassimilated portions in the form of saccharine excrement, while the ants regurgitate some of the liquid to the mites which ask for it by aping, with their long, hairy, forelegs the antennal movements of hungry ants. In other words the ants serve as cup-bearers, distributing to one another and to the indolent, sedentary *Antennophori* the nectar which the tapster aphids and coccids keep drawing from their vegetable hosts.

Owing to this intimate serial ethological arrangement the worker *Lasii*, unlike most of our ants, do not have to come out on to the surface of the ground to seek their food, but live a hypogaeic, or subterranean life. The eyes of these workers have therefore become so minute that their visual powers must have nearly or quite disappeared. We can, perhaps, best appreciate the relations of these ants to their parasites, if we fancy ourselves blind and condemned to live in dark cellars and continually occupied in pasturing and milking fat, sluggish cows that yielded quantities of strained honey instead of milk. Then let us suppose that occasionally there alighted on our cheeks or backs small creatures which took great care not to annoy us by placing themselves in positions asymmetrical to the median longitudinal axis of our bodies, and stretched forth to us from time to time small, soft hands like those of our children, begging for a little of the honey. Should we not, under the circumstances, treat these little Old Men of the Sea with much lenity or even with something akin to affection?

During the coming spring I shall endeavor to make a more detailed study of the habits of *A. donisthorpei* and of the other species *A. wasmanni*, which, to judge from its longer appendages, must be an even more persevering and impudent beggar. For the present I shall confine myself to giving a description and several figures of both sexes of the two species, so that they may be easily recognized by other students of our North American myrmecophiles.

Antennophorus donisthorpei sp. nov.

Male. (Figs. 1, 2, 4 and 8.) Body nearly as broad as long, broadly oval or subtrapezoidal, broader behind than in front, with very obtuse anterior and posterior borders, the latter in some specimens almost straight. In

profile the dorsal scute is only moderately convex. Dorsal surface and legs yellowish brown, the former smooth and shining, not polygonally areolated under a high magnification, with a darker brown, O-shaped vitta enclosing a large, elliptical, pale central area and separated by a pale border from the edge of the dorsal scute. Ventral surface of body yellowish; sternal and anoventral scutes brownish. Dorsal surface densely clothed with short, rather stout hairs, which are distinctly longer and sparser in front and on the sides than behind. Legs short and stout, anterior border of coxa and trochanter of three posterior pairs not laciniate-denticulate, but entire. Hairs on the three posterior pairs of legs short, stout and distinctly curved, especially towards their tips. Sternum in some specimens connected with the lageniform anoventral scute by a pair of slender processes, which surround the genital orifice. In other specimens (Fig. 2) the two processes are separated from the anoventral scute, and in still others they may be continuous with this sclerite but separated from the sternum. Hairs on the sternum and anoventral scute very short and sparse. Chela rather small, its fixed digit flattened, spatulate and curved, terminating in a round knob; movable digit dilated at the tip where it is bilobed, with one of the lobes folded back.

Length: 750–790 μ; breadth: 700–800 μ.

Female. (Figs. 3, 5, 6 and 7.) Resembling the male in form and coloration, but somewhat larger. Sternum large, median and entire, with a very few short hairs on its posterolateral portions. Anoventral scute subcordate, prolonged anteriorly as a slender tapering process which terminates between the lips of the genital scutes; covered behind with short, sparse hairs. Genital scutes resembling those of *A. foreli* Wasm. Chela with slender tapering digits, pointed and hooked at their tips and armed on their inner edges with very minute, blunt denticles.

Length: 760–825 μ; breadth: 780–980 μ.

Described from several males and females taken May 8th, 1909 on the Faulkner Farm, near Forest Hills, Boston, Mass. They were attached to the gular surface of workers of the following ants: *Lasius flavus* L. subsp. *nearcticus* Wheeler; *L.* (*Acanthomyops*) *latipes* Walsh; *L.* (*A.*) *claviger* Roger and *L.* (*A.*) *interjectus* Mayr.

The new species, which I dedicate to Mr. H. S. J. Donisthorpe, the well-known student of British myrmecophiles, seems to be most closely related to the European *A. foreli* Wasm., but the shape of the body is more trapezoidal, the hairs on the dorsal surface are shorter and more abundant, the pale dorsal area is larger, the chelar digits of the female have much smaller and blunter teeth and a different flagellum, and the male chela is of a very different shape, to judge from the figures of Berlese and Karawaiew.[1] The sternum of the

[1] Weitere Beobachtungen über Arten der Gattung Antennophorus. (Russian) *Mem. Soc. Natur. Kieff.* XX, 1908, pp. 209–230, 1 fig.

female is much longer and very different in outline and the anoventral scute is less tapering in front.

Several of the female specimens of *A. donisthorpei* each contain a single, large, mature egg, as shown in Fig. 3. This seems to indicate that *Antennophorus,* unlike many other mites and the ticks, is in the habit of producing only one egg at a time. This egg is perhaps attached to the surface of the ant which is infested by the mite.

Antennophorus wasmanni sp. nov.

Male. (Figs. 10, 11, 12, 13 and 15.) Body very convex above, nearly as broad as long, very broadly oval, distinctly wider behind than in front, with its anterior and posterior ends very obtusely angular. Upper surface smooth and shining, polygonally areolated under a high magnification, brown, without a darker vitta or perceptibly paler central area, and covered with longer, more slender and somewhat sparser hairs, than the preceding species. Legs and scutes of the ventral surface brownish, remaining portions yellowish. Legs decidedly longer than in *A. donisthorpei,* coxæ and trochanters of three posterior pairs not laciniate-denticulate. Hairs on these pairs of legs very long and straight. Anoventral scute broad in front, connected with the sternum by two slender bands which enclose the genital orifice. Chela very long; digits slender, subequal, the fixed one simple but not spatulate, its tip curved, blunt and finger-like; the movable digit with a hooked, pointed tip and a flattened, lobular process (adnate spur) on its outer side.

Length: 900 μ; breadth: 830 μ.

Female. (Figs. 14, 16, 17 and 18). Resembling the male in form and coloration but somewhat larger. Body broader than long. Sternum larger, subelliptical, median, entire and apparently nude. Anoventral scute short, subcordate, with a rapidly tapering anterior process that terminates between the genital scutes. The latter resemble those of the preceding species and *A. foreli.* Hairs on the anoventral scute very short and sparse. Chela with subequal digits, each terminating in a hooked point, their inner borders armed with larger denticles than in the preceding species and one large tooth on the movable digit.

Length: 990 μ; breadth 1040 μ.

Described from two males and two females taken May 22d, 1909, on the Faulkner Farm at Forest Hills, Boston, Mass., with workers of *Lasius umbratus* Nyl. var. *aphidicola* Walsh. The mites were not seen till after they had been killed in alcohol with their hosts.

This species is dedicated to the Rev. E. Wasmann, S. J., who has contributed so much to our knowledge of the myrmecophilous insect of all lands. It may be readily distinguished from the preceding species by its much more convex dorsal surface, longer legs, the longer

and straighter hairs on the three posterior pairs of these appendages and the shape of the chelæ of the two sexes. Like the preceding species, *A. wasmanni* seems to be most closely allied to the European *foreli* in having an undivided sternum in the female. In the convexity of its body it resembles *A. pubescens* Wasm., but the male chela is of an entirely different shape, the female sternum is entire and there are fewer hairs on this sclerite and on the anoventral scute of both sexes.

EXPLANATION OF PLATES.

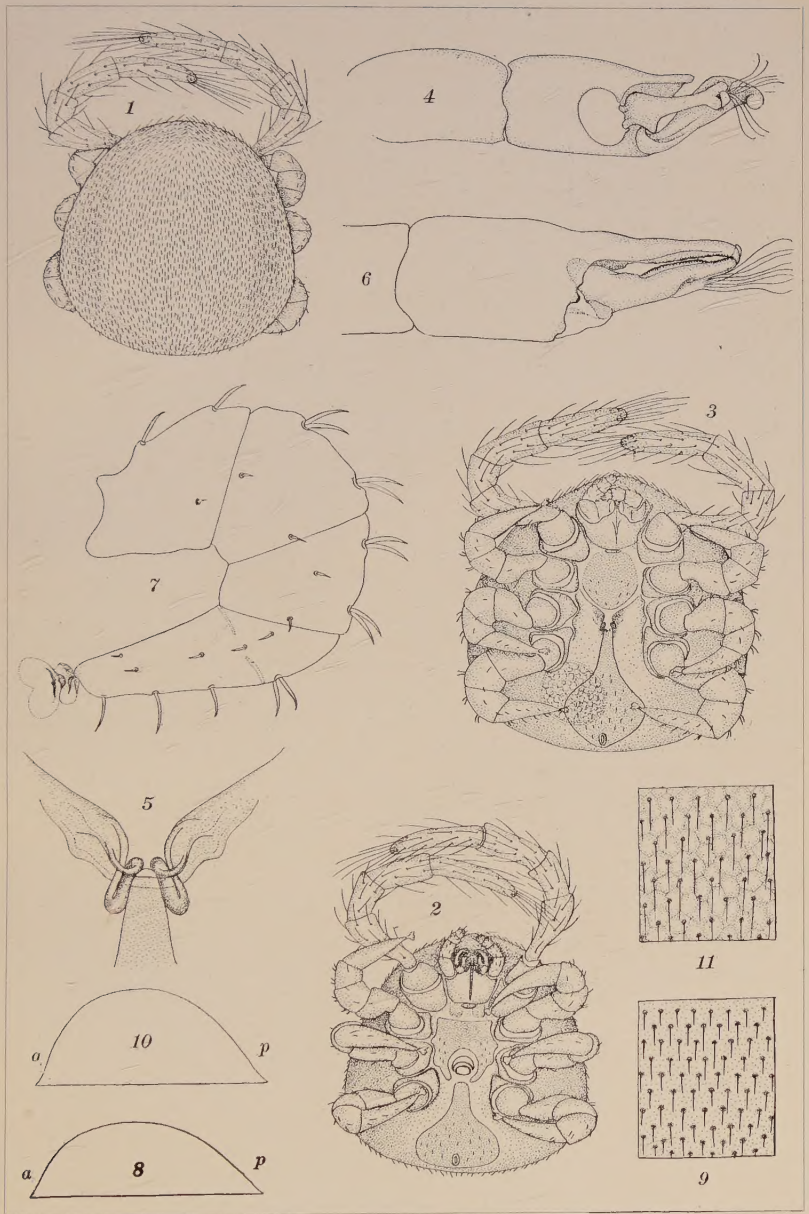
Plate I.

Fig. 1. *Antennophorus donisthorpei* sp. nov.; male; dorsal view.
Fig. 2. Same, ventral view.
Fig. 3. Female *A. donisthorpei*, ventral view.
Fig. 4. Chela of male, ventrolateral view.
Fig. 5. Genital scutes of female.
Fig. 6. Chela of female; dorsal view.
Fig. 7. Left hind leg of female, ventral view.
Fig. 8. Dorsal scute of *A. donisthorpei*, in profile; *a*, anterior; *p*, posterior end.
Fig. 9. Portion of dorsal integument near posterior end of body.
Fig. 10. Dorsal scute of *A. wasmanni* sp. nov., in profile; *a*, anterior; *p*, posterior end.
Fig. 11. Portion of dorsal integument of *A. wasmanni* near posterior end of body.

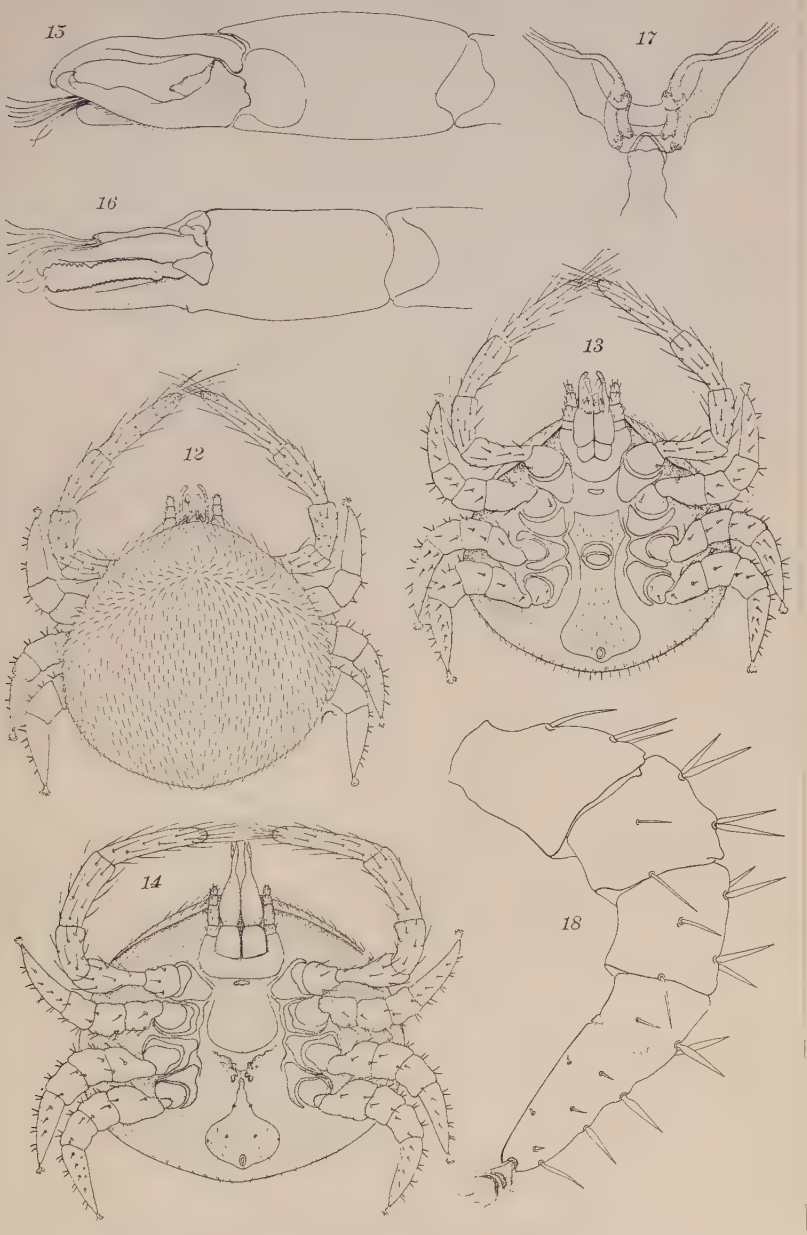
Plate II.

Fig. 12. *Antennophorus wasmanni* sp. nov.; male, dorsal view.
Fig. 13. Same, ventral view.
Fig. 14. Female, ventral view.
Fig. 15. Chela of male, ventral view.
Fig. 16. Chela of female, ventral view.
Fig. 17. Genital scutes of female.
Fig. 18. Left hind leg of female, ventral view.

Wanted, caterpillars, especially of exotic families, and named micros, preferably in alcohol. Wm. T. M. Forbes, Clark University, Worcester, Mass.



WHEELER — MITES OF THE GENUS ANTENNOPHORUS.



WHEELER — MITES OF THE GENUS ANTENNOPHORUS.

A REVISION OF THE SPECIES OF AGATHOMYIA OF THE EASTERN UNITED STATES.

By Charles W. Johnson.

Boston Society of Natural History, Boston, Mass.

Table of Species.

1. Head, thorax and abdomen black.....2.
   Head black, thorax and abdomen fulvous.....**fulva** Johns.
2. Abdomen broadly banded with yellow, scutellum yellow. **pulchella** Johns.
   Abdomen not banded.....3.
3. Thorax and abdomen both maculated with greenish white, halteres black.....**notata** Loew.
   Thorax only maculated with greenish white, halteres yellow. **divergens** Loew.
   Thorax and abdomen without maculations, tip of abdomen in the female cinereous, knobs of the halteres black.....**talpula** Loew.

Agathomyia fulva Johnson.
Callimyia fulva Johns., Psyche XV, p. 59, June, 1908.

At the time I described this and the following species, I did not have access to Verrall's work on the British Flies. A further study of these, together with the types of *divergens* and *talpula* Loew, shows that the four species are all true *Agathomyia*.

Agathomyia pulchella Johnson.
Callimyia pulchella Johns., Psyche XV, p. 58, June, 1908.

Since describing this species from specimens obtained at St. Johnsbury, Vt., June 27, 1906, I have collected two specimens on Mt. Ascutney, Vt., July 11, and one at Brattleboro, Vt., July 15, 1908.

Agathomyia talpula Loew.
Callomyia talpula Loew, Centur., IX, 81 (1869).
Callimyia talpula Johns., Psyche XV, p. 59 (1908).

A female of this species was obtained at East Walpole, Mass., May 26, 1908.

Agathomyia divergens Loew.
Callomyia divergens Loew, Centur., V, 77 (1865).

Aside from the type there is a specimen in the Museum of Comparative Zoology, from the District of Columbia.

Agathomyia notata Loew.

This species has been obtained by the writer at Westville, N. J., July 2, 1893; Riverton, N. J., June 1; Auburndale, Mass., August 28; and Hanover, N. H., July 5, 1908.

Callimyia venusta Snow.

I was very much surprised to capture at Shackford Head, near Eastport, Maine, July 14, 1909, a specimen of this beautiful species, agreeing in every respect with the description. It is a true *Callimyia*.

Unusual Parasitic Habits of an African Ephydrid. By Dr. C. Wellman, translated from Zeitschr. wiss. Insektenbiol., Nov. 18, 1909, p. 356.

While collecting insects some time ago in West Africa, a small fly which was laying eggs on living ants (Cremastogaster sp.) attracted my attention. The fly rested on her victim, inserted her ovipositor, and then carried the seemingly perplexed and helpless ant into a small deserted spider burrow, where the ant remained until the fly larva had emerged. It was interesting to see how well the fly managed so strong a fighter as the ant, for this ant can sting severely. At first I mistook the fly for a Phorid as I knew *Phora formicarum* to be parasitic on *Lasius niger*, but on closer examination by specialists, it proved to be a member of the Ephydridae representing a new genus and species. I take this occasion to present these observations as this kind of parasitism is to my knowledge something entirely new among Diptera.

B. B. B.

THE CHALCIDOID PARASITES OF THE COMMON HOUSE OR TYPHOID FLY (*MUSCA DOMESTICA* LINN.) AND ITS ALLIES.[1]

By A. A. Girault and George Ethelbert Sanders.

The University of Illinois.

Habits in General and Biology.

A. *Oviposition.* This appears to be the only function of the female. When thus engaged she is not easily disturbed and the function is normally performed even in small capsules or vials, and in the insectary at various times, females were often observed attempting to gain entrance to breeding-cages containing their hosts; in the case of large cages they were quite often successful and under certain conditions it was impossible to keep them out. The following detailed, though fragmentary observations were made on ovipositing females.

(1) Sept. 12, 1908.— The female often faces towards the caudal end of the host puparium when engaged in ovipositing — on this date, in the cases of 8 host puparia (*Phormia regina*), apparent oviposition was observed once in four cases and twice in the other four — the times of these ovipositions were between 9:55 A. M. and 1:20 P. M. and the time required to deposit a single egg varied from $1\frac{1}{2}$ minutes to 16, averaging $7\frac{1}{2}$ minutes; the particular spot on the host puparium into which the ovipositor of the female was inserted was usually in the region of the 4th and 5th segments, but varied to the 6th and 7th or 7th and 8th. The hole made by the ovipositor was not distinct afterwards, but in many cases it became covered with a white mycelium-like growth the nature of which we have not determined. (2) On Sept. 29, 1908, at 11:30 A. M., in the case of three virgin females ovipositing into the puparia of *Phormia regina*, the ovipositor was inserted for its full length for 3, 7 and 8 minutes respectively. (3) On Sept. 13, 1908, a female was watched while ovipositing into a hard puparium of the Phormia. The puparium was pierced by rotating the ovipositor and pressing it down, the force of the pressure often causing the organ to bend, when the rotary motion was more easily seen; this continued

[1] Continued from Vol. XVI, p. 132.

for 11 minutes; the abdomen, during this time, was inclined upward, its tip applied to the surface and the ovipositor appearing as a perpendicular rod issuing from the venter slightly beyond the proximal third. After drilling through the crust of the puparium, the rotary motion was considerably lessened but not entirely discontinued and 10 more minutes were consumed in working the ovipositor back and forth, apparently in order to enlarge the aperture, the edges of which were frayed. The ovipositor was then pushed farther into the aperture, the abdomen moving up and down slightly and gradually being triangularly or conically produced at the base of the ovipositor, and as the latter entered farther, approaching nearer and nearer to the surface of the puparium, until after 30 seconds the ovipositor was fully inserted. The female then remained motionless for $3\frac{5}{6}$ minutes, when the ovipositor was partially redrawn and reinserted two or three times, and finally wholly withdrawn from the host, assuming its usual concealed position within the valves along the venter. Upon the withdrawal of the ovipositor, the female immediately left the host. The time that she was engaged in the whole operation was $25\frac{1}{3}$ minutes. (4) Observations made on three females depositing eggs into puparia of the Phormia, on Sept. 29, 1908, showed in three instances that the ovipositor was fully inserted for 70, 90 and 95 seconds respectively. (5) On Sept. 18, 1908, a female of this parasite was confined in a small homeopathic vial with a quantity of muscid puparia of varying ages — some three or four days old, some but several hours. The female chose an "old" puparium, formed about two days, and apparently deposited three eggs into it, one following the other. At first, she chose a place for inserting the ovipositor by examining closely the entire surface of the host; the ovipositor was then guided to the spot by bending the abdomen, the whole body convexly bent, the head turned as though the insect was watching the operation; as soon as placed, the ovipositor was released from the valves along the venter and the abdomen assumed its usual position. Piercing the shell of the puparium required $1\frac{1}{2}$ minutes; the ovipositor was then inserted for its entire length, without other delay, and as quickly withdrawn, fifty seconds being occupied in enlarging the hole. After this short period of time, the ovipositor was pushed in again for its entire length, remaining so for forty-five seconds, during which time, apparently, the egg was deposited. After the ovipositor was withdrawn, the parent parasite carefully examined the puncture with the antennae

and mandibles and apparently also by means of sight. (6) The deposition of an egg observed at 9:45 P. M., Sept. 14, required 16 minutes; the host was *Phormia regina*. Another observation made at 10:15 A. M. the same day, showed that the act required 8 minutes; the host puparium was that of *Musca domestica*; in the latter case, the ovipositor was inserted into the 9th segment of the host. A female was observed to deposit an egg in confinement at 7:30 A. M. to-day. (7) A female confined at 9:20 A. M., Sept. 10, deposited into puparia of the Phormia at 9:32 A. M. and 1:20 P. M. the same day. One confined at 10 A. M. the same date with 2 puparia of the same host oviposited at once. (8.) In the cases of 4 females confined separately in vials each with 4 (in one case 8) puparia of *Cynomyia cadaverina* Desv., April 29, 1909, oviposition occurred with one female at 10:25 P. M., April 30, and again at 9 P. M., May 1; no other observations were recorded. (9.) Nine males and twenty females confined at 11:20 A. M., April 29, with 10 puparia of the same host commenced oviposition about noon, or sooner, and oviposition was observed at nearly every hour between 9 A. M. and 11 P. M., for several days.

B. *Nature of the Parasitism.* Examinations made of parasitized hosts, showed that in all cases, the parasite is "social" or gregarious and does not attack the host until after the formation of the puparium, preferably after the latter has been formed for at least twenty-four hours. Puparia of *Phormia regina* examined, were in some cases filled entirely with the larvae of the parasite which had totally consumed the host pupa; for example, from one puparium 47 larvae of the parasite were removed; from another 8 larval parasites were removed, together with a shriveled pupa of the host — none of the parasitic grubs had entered the body of the latter, which indicates that the parasites are external as far as the host pupa is concerned, obtaining their nourishment by means of absorption; in the case just cited, one of the parasitic larvae was attached to the head of the host pupa over the eye, one to the thorax and six to the abdomen. In a third Phormia puparium, there were found 21 larval parasites, the host pupa being totally consumed; in four more single cases there were 8, 13, 13 and 16 larvae of the parasite respectively. In another, 27 parasitic pupae were found, from a single puparium of *Sarcophaga* sp. "e" 22 ♂♂ and 4 ♀♀ of the parasite were taken. As a rule, the remains of a parasitized host — the fully formed pupa — is a flat, scale-like mass apparently consisting of the ventral shell of the pupa and that of the head; for

example, the thecae of the eyes, legs and wings are discernible, and the remains are not much shrunken, so far as the original length is concerned. In the case of *Cynomyia cadaverina*, in one puparium infested with 21 larvae of the first spring generation, the parasites were all attached to the dorsal surface of the host from the pronotum to the tip of the abdomen; these parasitic larvae were nearly full-grown. But in another puparium of the same host, in which 13 larvae were found, their attachment to the host appeared to be haphazard, and the host pupa was considerably shrunken, especially in width. It is evident, from their appearance, and from the fact that the larger larvae are found attached externally to the host — between it and the inner walls of the puparium — that the larval parasites obtain their nourishment through the body wall of the host pupa, leaving the integument intact. In both of the latter cases, the host pupae were nearing the final ecdysis when they were attacked by the parasites.

Although gregarious, the host is not as completely destroyed as by *Spalangia*, *Muscidifurax* or *Pachycrepoideus*, which though solitary parasites, reduce the host to a mere flat unrecognizable shell.

In addition to the foregoing, Mr. Maurice C. Tanquary has kindly collated the following records from our rearing notes:

TABLE I. NUMBER AND SEX OF PARASITES (*Nasonia brevicornis*) ISSUING FROM PUPARIA OF *Phormia regina*.

Males	Females	Larvae.	Total.	Males.	Females.	Larvae.	Total.
8	7		15	0	5		5
3	6		9	0	1		1
10	4		14	5	0		5
5	3		8	9	6		15
1	13		14	1	6		7
9	5		14	6	16		22
10	17		27	0	5		5
7	6		13	16	5		21
13	11		24	0	7		7
4	9		13	2	12		14
6	15		21	1	4		5
0	17		17	3	9		12
15	5		20	3	8		11
1	21		22	7	12		19
10	4		14	6	4		10
4	6		10	1	10		11
6	7		13	3	9		12

Males.	Females.	Larvae.	Total.	Males.	Females.	Larvae.	Total.
5	4		9	9	13		22
7	1		8	9	10		19
1	10		11	7	5		12
17	0		17	10	9		19
2	7		9	4	5		9
4	11		15	0	4		4
4	10		14	11	8		19
1	6		7	11	4		15
3	7		10	11	18		29
2	11		13	1	0	5	6
2	3		5	5	4		9
5	11		16	2	0		2
11	0		11	2	6		8
1	9		10	0	4		4
17	5		22	3	1		4
38	4		42	5	1		6
6	10		16	10	11		21
1	2		3	3	4		7
1	2		3	13	4		17
4	7		11	5	10		15
15	4		19	4	2		6
6	0		6	1	10		11
5	1		6	2	8		10
5	5		10	22	6		28
11	0		11	3	2		5
5	14		19	3	8		11
0	4		4	9	6		15
9	11		20	9	3		12
6	5		11	8	5		13
2	1		3	0	2		2
15	12		27	23	11		34
8	8		16	4	2		6
1	7		8	4	5		9
2	1		3	9	3		12
7	9		16	6	9		15
8	12		18	9	3		12
9	3		12	7	1		8
0	6		6	1	2		3
7	9		16	3	7		10
12	7		19			8	
4	12		16			6	
0	3		3			6	
9	13		22			4	
7	11		18			6	
1	9		10			23	
3	8	3	14	3	3		6
			Totals	713	789	61	1555

The puparia from which the foregoing records were made were selected at random from a large quantity formed by maggots obtained August 28, 1908, in the decomposed cadaver of a large angora cat, taken from the city dumping-grounds, Champaign, Illinois. Each puparium was confined separately in a gelatine capsule, until the parasites emerged; they were confined on Sept. 15, and on Sept. 29 the majority of the parasites had emerged; the count was not made, however, until nearly a month later, or on Oct. 19, 1908.

In 119 puparia there were 1496 individuals of *Nasonia brevicornis*, of which 710 were males and 786 females. The average number of males in each puparium was 5.96, of females 6.60; the average number of specimens from each puparium was 12.57. Of the whole number, 52.4% were females and 47.6% males. The averages do not include 8 larvae found in two of the hosts.

On the date of counting — October 19th — 8 of the puparia were found to contain larvae of the parasite, some in addition to the adults, over half of the larvae being still alive; but 14 of the puparia contained only dead pupae of the host, that is to say, were not parasitized. So that of the 140 puparia examined, 14 were not parasitized, 126 were. The total number of parasites in the 126 parasitized puparia, including larvae, was 1555, and on this basis, the average for each host was 12.34, very near the former average. The maximum number of parasites obtained from a single host (*Phormia regina*) was 47, recorded in the first paragraph of this section; the minimum was 1, recorded in the table.

The meconial discharges of this parasite, found scattered through the host puparium, are brownish yellow or dark olive green in color and consist of small conglomerations of round pellets, or are sometimes in irregular chains like some bacteria, but are never single, solid pieces as with *Pachycrepoideus*, *Spalangia* and *Muscidifurax*.

C. *Length of the Period of Oviposition.* In the cases of two females captured and confined together with eight puparia of *Musca domestica* at 11:30 A. M., Sept. 10, the first oviposition was observed at 1 P. M., Sept. 10, the second at 7:30 A. M., the following day, the third at 10 A. M., Sept. 14, and the fourth and last, fifteen minutes later; here, at least, oviposition was continued over a period of $3\frac{1}{2}$ days or more.

In the case of 9 males and 20 females, parents of the first spring generation of 1909, which were confined at 11:20 A. M., April 29, 1909, with 10 healthy puparia of *Cynomyia cadaverina* which were

freshly emerged (average, 9 A. M., April 29) and of the same age, oviposition was begun at noon the same day and continued steadily until at least 9 P. M., May 2, 1909, when further observations were interrupted. These facts also hold for a single female of the same lot confined separately with 8 of the hosts.

D. *Time Elapsing between Emergence and Reproduction.* Eleven adults of mixed sexes emerging from a single puparium of *Phormia regina*, from 11:45 A. M. to noon, Sept. 28, 1908, were at once confined together with four healthy puparia of the same host. At noon the following day oviposition was observed, or after a period of twenty-four hours. One pair of adults emerging at 8 A. M., Sept. 30, was confined immediately with seven healthy puparia of the same host; at 8:13 A. M. mating was observed and at 6:50 P. M. the same day the female was observed ovipositing; or after $10\frac{1}{2}$ hours. Mating in this instance followed almost immediately after emergence, and lasted for 14 seconds. In the case of the parents of the first spring generation of 1909, mating followed almost immediately after emergence and oviposition about 3 hours later.

E. *Duration of the Pupal Stage.* This was obtained in one case only. A larva pupated during the night of Sept. 17–18, 1908, the newly formed pupa being yellowish white; by the twenty-first of the same month, the pupa had assumed nearly the colors of the adult, dark greenish, the head and thorax coloring first, the abdomen a few hours later. The resulting adult female emerged at 10 A. M., Sept. 23, 1908, making a pupal stage of approximately $5\frac{1}{2}$ days. The average length of this stage for the first spring generation (17 cases) was 9 days (May 14–23, 1909).

F. *Length of the Life Cycle.* The few incidental observations obtained on this point are herewith given in tabular form. (Table II, p. 16.)

Thus while the average daily effective temperature shows a gradual decrease, there seems to be no corresponding increase in the duration of the cycle.

The duration of the cycle appeared to be somewhat longer in the case of the first spring generation, however, when the daily average effective temperature was low. Thus, hosts exposed to recently mated adults from noon, April 29, 1909, to late on May 2 — oviposition continuing throughout that time — were filled with the nearly full-grown larvae of the parasite on May 13, pupation com-

TABLE II. DURATION OF THE LIFE CYCLE IN *Nasonia brevicornis*, 1908.

Lot No.	Host.	Oviposition observed.	Emergence of adults.	No.	Approximate length of cycle, days.	Degrees Fahr. Effective tmp.[1]	
1	*Musca*	Sept.9–10	Sept.26	6 ♂'s, 10 ♀'s	16	35.9°	574.0° (Sept. 10–25).
2		Sept.10, 11 a.m.	Sept.28	1 ♂, 2 ♀'s	18	35.3°	634.7° (Sept. 10–27).
3		Sept.10, 1 p.m.	Sept.25, 10 a.m	9 ♂'s, 12 ♀'s	14⅞	36.2°	538.3° (Sept. 10–25).
4		Sept.10, 10 p.m.	Sept.25, 10 a.m.	1 ♂, 6 ♀'s	14½	35.5°	514.9° (Sept. 11–25).
5		Sept.11	Sept.28	2 ♂'s, 17 ♀'s	17	34.3°	578.6° (Sept. 12–28).
6	*Phormia*	Sept.14, 7 a.m.	Oct.1, 7 a.m.	2 ♂'s, 8 ♀'s	17	31.4°	533.9° (Sept. 14–30).
7		Sept.18, 6 p.m.	Oct.2, 9 p.m.	7 ♂'s, 12 ♀'s	14⅓	28.3°	408.1° (Sept. 18–Oct.2).
8		Sept.29	Oct.15	17 ♂'s	16	19.6°	314.3° (Sept. 30–Oct. 15).
Av:				14	15.9	32.6°	512.1°

mencing on May 14 at the average time of 4 P. M. Emergence of the adults occurred at 4 P. M., May 22, becoming general at 3 P. M., May 24. Hence, taking average time, the life cycle in this case had an average duration of 22½ days, natural temperatures.

G. *Progeny of a Single Female.* The number of observations which we were able to make concerning the fecundity of the species was not large, but those which are tabulated in the attached table (table III) appear to show that there is quite a wide range, within certain limits, which is more or less dependent upon the number of host puparia available for purposes of oviposition and also the host species. For instance, it is at once noticed that the most productive females had access to a comparatively large number of the host

[1] Inception of development taken as 43° Fahr. Sums of daily averages.
[2] Daily averages.

puparia, of which they made use for purposes of oviposition, whereas those having access to but one or two host puparia, especially those of the smaller host, *Musca domestica*, produced the least progeny. These experiments were performed at various times in the laboratory and are by no means conclusive, that is, do not establish the range or average of fecundity.

TABLE III. PROGENY OF SINGLE FEMALES OF *Nasonia brevicornis*.

Female No.	Date, 1908.	Host.	No. of hosts exposed.	No. of hosts infested.	Progeny of single females.			Minimum.	Maximum.	Range.
					♂'s.	♀'s.	Total.			
1	Sept. 25	*Musca*	1	1	1	6	7			
2			1	1	4	6	10			
3			1	1	5	6	11			
4		*Phormia*	1	1			27			
5			2	2			38+[1]			
6			4	4			39			
7	Sept. 28	*Musca*	4	4	2	17	19			
8			1	1	1	2	3	3		
9	Sept. 30		1	1	2	4	6			
10	Oct.	*Phormia*	5	4	9	18	27			
11	Oct. 1		1	1	2	8	10			
12	Oct. 20		Many	—	7	12	19			
13			Many	—	4	22	26			
14			130	17	21	57	78			
15			86	22	38	65	103		103	100
16		*Chrysomyia*	17	12	31	53	84			

It is thus seen that in one instance, a female was able to parasitize successfully 22 host puparia and another 17, when quite a number were available. The observations do no more than indicate the probabilities and possibilities of fecundity for the species. Apparently, all of the females concerned were fertilized. From the fact that single ovipositions take so much time, as well as for other reasons, we strongly suspect polyembryony in this connection.

H. *Proportion of the Sexes.* The following results, recorded in table IV, comprise actual counts of over seven thousand specimens, including practically every individual of this parasite reared or observed by us during the period of breeding, excepting one thousand individuals of mixed sexes released for experimental purposes.

[1] All from one of the puparia; the numerous larvae in the other died and were not counted.

The specimens are from various sources, but the great majority were reared from puparia obtained under natural conditions, so that the general result should show a nearly normal or actual ratio of the sexes. The table follows.

TABLE IV. PROPORTION OF THE SEXES IN *Nasonia brevicornis*.

Lot No.	Source.	Date. 1908.	Males.	Females.	Total.	Ratio.	Remarks.
1	Principal misc. rearings during season	Sept. 9–Oct. 20	142	438	580	1:3	Comprises all accessioned rearings. See pp. 7–9.
2	Nason Collection	May 11–Sept. 17 1894–1895	1	9	10	1:9	From sweepings, Algonquin, Illinois.
3	*Phormia regina*	Sept. 29	710	786	1496	1:1+	From a single host lot from a decomposed cadaver, city dumping-grounds.
4	*Phormia regina*	Oct.	1895	2808	4703	1:1+	Same as lot No. 3, later, excluding 1000 removed at random for experimental purposes.
5	*Phormia regina*	Oct.	228	116	344	2:1+	Host puparia in fecal matter, miscellaneous.
6	Various	Sept.	41	49	90	1:1+	Reared.
7	Various	Sept.–Oct.	64	82	146	1:1+	From isolated puparia of *Musca*, *Sarcophaga*, *Phormia* and *Chrysomyia*.
Sums:			3081	4288	7369	1:1+	
Per-cent.:			41.81%	58.19%			

The general result shown in the table is about what one would expect if consideration is taken of the fact previously pointed out, namely, that the species is occasionally parthenogenetic, which, however, follows no general law in the Hymenoptera. It should be explained, in regard to lot No. 4 in the table that, after it was separated from lot No. 3, the first 1000 individuals of mixed sexes coming to

the light were removed and released to be used in an experiment to test artificial propagation. Unfortunately, these were not counted in regard to sex, so that it is unknown whether the females greatly predominated, a result which we were led to suspect from the fact that this sex appeared to be more attracted to light; for the first 932 individuals taken from the experiment, after all emergences, were females, dead in the exit-tube, which alone was light. Lot No. 3 is the most complete record made, none of the emerging parasites having escaped, and we are inclined to think that it represents the actual ratio of the sexes, the females slightly predominating.

The proportion of the sexes in a small number of the parasites which hibernated as larvae, hence the parents of the first spring generation, was as 37 males are to 61 females; these emerged during the last day of April, 1909. Their descendents or parents of the 2d generation were also of mixed sexes, being the progeny of fertilized females, there being 24 males to 45 females, which emerged on May 25, 1909.

I. *Emergence of the Adult.* In general, it may be stated that the adult parasites emerge from the host puparium through from 1 to 3 circular holes, situated variously, usually in the dorsal or dorso-lateral aspect; and when more than one exit-hole, the two or three are usually scattered or widely separated. The manner of emergence does not differ for sex. The exit-hole varies in diameter from about 0.75 to 1.50 mm.; it is usually larger and single when the host is *Musca* or *Chrysomyia* and smaller when *Phormia*, though this difference may be more apparent than real. Individual exit-holes may of course vary considerably in shape; for rarely it may involve the whole of one end of the host puparium and is then relatively very large and irregular. The margins of the exit-holes are always jagged or serrate, showing that the adults gnaw their way out. Specific instances may better illustrate.

From a single puparium of *Musca domestica*, 1 male and 6 females issued from a single dorsal exit-hole just behind the head end; several parasites of both sexes issued from another puparium from a hole in the dorsal aspect of the 7th segment; several adults of both sexes issued from a third puparium through two exit-holes in the cephalic and caudal segments respectively. Again, 1 male and 2 females emerged from a more irregular exit-hole in the dorso-lateral aspect of the caudal or anal segment of the host. In a last case recorded, 2 ♂♂ and 4 ♀♀ issued from a single hole near the cephalic end of the host.

In the case of *Phormia regina*. From one puparium, 7 females issued from a single hole in the lateral aspect of the 3rd segment; from a second, 37 males issued from 2 holes in the ventro-lateral aspect of segments 2 and 5; from a third 15 males issued from a single hole in the dorso-lateral aspect of segment 5; from four more puparia, of the same lot, 9 males and 18 females issued, making but a single exit-hole in each of the hosts. In each of the following instances several parasites issued in the manner stated; both sexes were present:

(a.) 2 similar holes in a longitudinal line, dorsal aspect of 2d and 4th segments. (b.) 3 holes, lateral aspect, 2 on one side at segments 3 and 7, the other at segment 2 on the opposite side. (c.) 2 holes, lateral aspect of segment 5 and tip of the anal segment. (d.) 2 holes, dorsal aspect of segment 3 and dorso-lateral aspect of the anal segment. (e.) 2 holes in an oblique line, dorsal aspect, 5th and 7th segments. (f.) 1 hole, lateral aspect of segment 3. (g.) 1 hole lateral aspect of segment 6. (h.) 2 holes, opposite sides, lateral aspect of penultimate segment and dorso-lateral aspect of segment 7. (i.) 3 holes, scattered. (j.) 2 holes. (k.) 2 holes caudal end, dorsal and ventral aspects of the penultimate segment.

With *Chrysomyia*, several adults issued from a single puparium through a single hole in the dorso-lateral aspect of the cephalic segment; from 12 puparia of this species, there emerged 32 males and 64 females, or an average of 8 to each; in the case of 8 of the puparia, but a single exit-hole was present, nearly all in the dorsal aspect of the 3d, 4th, 5th and 8th segments; the remaining 4 hosts bore each 2 exit-holes, usually widely separated.

In *Cynomyia cadaverina* Desv., 8 ♂♂, 16 ♀♀ issued from a single puparium from two equal round holes in the dorso-lateral aspect of segments 3 and 5.

In regard to the time of emergence, the males usually emerge from 2 to 20 hours earlier than the females, a few emerging some hours previous to the simultaneous emergence of the majority, but there is considerable variation in individual cases. Thus some males may be the last to emerge, but the tendency is for them to emerge earlier than females.

J. *Local Abundance.* In order to show the local abundance of this parasite during 1908, we have merely to point out the fact that as many as eight thousand or more specimens were reared by us during the months of September and October. This large number

was reared quite incidentally, that is to say, without conscious effort on our part to augment it. From one experiment alone, there were obtained as many as seven thousand specimens, in round numbers, though we have no knowledge concerning the number which may have escaped. Further, the local abundance of this parasite is indicated by the fact that in at least a portion of the experiment just mentioned, a portion selected at random, the percentage of parasitism was as high as 90 per cent. We have evidence to show, on the other hand, that this percentage of mortality of the host was by no means general but was considerably lower on the average for this season of the year.

Thus, apparently this parasite had concentrated its attack at certain spots and while common over this locality was not exceedingly abundant over the whole, as the percentage of mortality given in the instance just mentioned would seem to indicate.

It was the most abundant parasite present in our experiments and also the one which attacked the greatest numbers of different muscid hosts, the remaining chalcidoid parasites of importance mainly confining themselves to the house fly.

K. *Artificial Propagation.* An unsuccessful attempt was made during the last week of September, 1908, to test the effect of the artificial propagation of this parasite on a badly infested garbage heap at the city dumping-grounds, Champaign, Illinois. The attempt was made too late in the season, however, and in addition, bad weather immediately following their liberation undoubtedly prevented activity on their part.

On the afternoon of September 23, 1000 specimens of mixed sexes were scattered over the garbage heap, which at that time was a veritable breeding experiment on a large scale. Soon after their liberation, many of the parasites were noticed crawling over host puparia which had been formed about a half-inch below the surface of the soil along the edges of the garbage heap. Specimens other than those liberated were not noticed at the time, special search being made for them previous to liberation.

On the date the experiment was inaugurated the percentage of parasitism by this species was very low as we know from the results obtained from a collection at random of 186 puparia; for by November 6, 1908, 48 adult flies had emerged (of which 37 were *Musca domestica*), 6 *Spalangia* and 2 *Muscidifurax raptor* Girault and Sanders MS. An examination made of the remaining 130 hosts, which were hibernat-

ing in confinement as puparia, revealed the fact that the majority had died and that no further parasitism had occurred. After inauguration of the experiment, weekly collections of the host puparia were made from the heap of garbage and continued until the first week of November. The lot collected on September 30 had one puparium infested with *brevicornis* but from these collected thereafter no results were obtained, the collections unfortunately being placed in the warm insectary and subsequently neglected. Nor were any adults of the parasite seen during the visits to the heap in the late fall and early winter. From a lot of hosts collected on November 14, however, the garbage then being covered with snow, sometime during late November single females of *brevicornis* issued from a puparium of *Chrysomyia macellaria* and from one of *Phormia regina*; these were evidently greatly accelerated in development by the warmth of the insectary and would otherwise have hibernated within the puparia of the hosts. The remaining lots were examined early in the spring of 1909, but everything was dead and no indications of parasitism were found.

L. *Hibernation.* This parasite hibernates as a full-grown larva in the puparia of its various hosts, pupating early in the spring and emerging shortly afterwards, the earliest record being April 28, 1909 — in numbers the following day. The following data have been gathered concerning this phase in its life-cycle.

Case I. On April 28, 1909, a single broken puparium of *Chrysomyia macellaria* was found in a vial in the cold insectary which had evidently been laid aside late in the previous October and subsequently overlooked. The vial had no data connected with it, so that the origin of the single host could not be traced. With the broken puparium were found a living male adult, partly excluded from the pupal integument and four healthy pupae of the parasite, two of which were uniformly deep black, showing the nearness of the final ecdysis; the other two were creamy white in color. The five meconia appeared to be freshly deposited. On the following day, by 9: 30 A. M., a female had emerged and shortly afterwards (9: 52) was observed mating with the male; at 10: 30 A. M., another female emerged. The two remaining pupae died.

Case II. A puparium of *Phormia regina* (Meigen) taken from refuse matter was inclosed in a vial on October 1, after having been carefully broken open in order to ascertain the presence of parasites; six apparently full-grown larvae of the parasite were found within.

On Oct. 28, 1908, it was noted that the larvae remained unchanged; no further note was made until April 28, 1909, when four fully colored pupae and one white one, were found, as well as five meconia, the shriveled remains of a larva of the parasite and the remains of the host pupa. At 10 A. M., April 29, 1 male and 2 females were found recently emerged; by the following day, at the same hour, another female had emerged. The remaining pupa died. All were in natural temperatures.

Case III. In a vial containing 20 puparia and 20 dead larvae of *Phormia regina* — including a single puparium of *Chrysomyia macellaria* — which were obtained from refuse matter late in October, 1908, and thus confined, there were found on April 28, 1909, 11 of the puparia infested with the parasite as follows. All were in natural temperatures.

No.	Host.	Larvae.	White pupae.	Black pupae.	Adults.	Total.
1.	*Phormia*	2 dead + 1.	3.	3.		9.
2.	(broken).			1.		1.
3.			2.	4.		6.
4.				9.	1♂, 1♀.	11.
5.				8.		8.
6.			1.	5.		6.
7.				6.		6.
8.				7.		7.
9.		1.		10.		11.
10.		1 dead.	6.	8.		15.
11.	*Chrysomyia.*			5.	1♂.	6.

In addition, lying loose in the vial were found 6 dark pupae and 1 recently formed, as well as one adult *regina.* Thus the parasite was found in three stages — nearly all of the larvae had pupated and the adults were just beginning to emerge. On the following day, emergence became general throughout the whole lot and was completed on May 3d, some of the younger white pupae dying. Of the total number of parasites in this case there were more females than males.

The sixty-one larvae recorded in table I, of which 38 were alive and healthy, were evidently hibernating, as the puparia had been in confinement for over a month, and those parasites which matured had long since emerged. A few *Phormia* puparia, infested and isolated on Sept. 15, 1908, contained living, full-grown larvae on Nov. 7, 1908.

M. *Courting and Mating.* Courting in this insect is not a complex habit. It follows almost immediately after emergence, at least in confinement. Where a number of both sexes are gathered together, all recently emerged, the males and females are constantly in motion, the former active, seeking the females, the antennae of both sexes also constantly in motion, held inclined upward in the natural position, giving quick, jerky, wavy movements. When one individual meets another, the antennae simply touch whichever portion of the body presents itself first and the two turn aside and pass on; or if they happen to be individuals of opposite sex and (apparently) the occasion is suitable — which is most often the case immediately following emergence — the male hastily climbs upon the back of the female, runs forward, and grasps her head with the fore feet, usually at the lateral aspect of the eyes or sometimes at the cheeks; the intermediate feet grasp some portion of the thoracic pleura, usually at the mesothorax and the hind feet take hold along the sides of the abdomen or the edges of the flat wings. The legs are not stretched out or used for embracing the body of the female but the hold is taken by the feet alone, and the position of the male is not strained but rather that of the natural position of rest. His body is parallel with and above the body of the female and projects beyond (cephalad) it, so that the head is between the upturned antennae of the female and stretched over hers, his abdomen reaching to a point above the third abdominal segment or to a point opposite to the distal end of the marginal vein of the fore wings upon which it actually rests. Having quickly attained this position, the male senses the antennae of the female with his own and immediately begins suit in earnest by rubbing his head up and down against the inner (mesal) surfaces of the flagella of the female,— which are held upward in a V-shaped position,— at the same time holding the scapes erect and apart and the flagella back, pointing laterad at right-angles to the scape and at every downward movement bringing the scapes together; this movement of the head is accompanied by a corresponding "petting" movement of the female flagella against the cheeks of the male. The up- and downward movements of the head are regular and continued for from 5 to 10 seconds, each completed movement occupying slightly less than a second of time; and they are alternated with a period during which the head of the male is motionless and his antennae sensing those of his mate, either by touching both of their tips to the tips of her antennae, or else by stroking

them up and down, the mandibles, maxillae and labium with both pairs of palpi are themselves in almost constant motion, but so far as observed, they play no part as organs of sensation, with the possible exception of the maxillary palpi. Sometimes, the male rubs but one of the flagella of the female, turning the head to one side. No other movements than these are observable, but there is some variation in the occurrence of either of the two movements described, and also in the number of times they are repeated before sexual union is permitted by the female. The male may be received coldly; he may make the movements without attempting union, or after alternating them three or four times, he may attempt union without success and then run forward to repeat the actions, and this may continue as long as the female permits, either resulting successfully or unsuccessfully. In the presence of other females, if received coldly, the male soon tires, leaves and seeks another mate. In order to attempt union, the male has to reverse his position, and run back to the tip of the abdomen of the female where he usually reaches over the tips of the wings and senses with the antennae, quickly turning and reaching around again with the tip of his abdomen, to gain entrance into the vaginal orifice. Or, on the other hand, he may simply back quickly to the caudal end of the female and attempt union. In one case, previously cited. coition lasted for fourteen seconds; in another, for ten seconds. Mating is promiscuous for both sexes.

The following example may be cited. From a puparium of a host a male emerged during the afternoon of April 28, 1909; by 9:30 A. M. the following day a female had emerged, and shortly afterwards the pair were in ardent courtship; at 9:45 A. M., sexual union occurred, lasting for ten seconds. The male then ran forward again over the back of his mate and rubbed his head up and down her flagella, one of the movements of courtship; he then left. After 30 seconds the male again quickly mounted his mate and repeated the two alternate movements, described in foregoing, continuously for 45 seconds and left for the same length of time. After a minute of attentions he made an unsuccessful attempt to unite with the female, and then left her for some time (12 minutes). Courting was recommenced after this interval of time, continuing for five minutes but with no attempt to unite. Subsequent matings followed during the next 24 hours, though 13 minutes after the last visit of the male, the female had crawled to some host puparia which engaged her attention, and both were less taken with each other.

N. *Effective Parasitism.*

What may be included under this term is an interesting phenomenon in those relations which a parasite sustains to its host. Under natural conditions it may never occur, and here it was observed accidentally. Whether or not a parasite can overcome the effects of development in a host at the time just preceding an ecdysis, when development is liable to be very rapid, is not a very important question, excepting when it is concerned with a host stage of very short duration such as is not present here. *Nasonia,* so far as we know, confines its attacks exclusively to the puparia of its various hosts; this stage is usually of short duration, but not exceptionally short as is the egg stage, so that the period of rapid development immediately preceding the final ecdysis, being short, would not materially prolong the period open to parasitism — that is, the pupal stage — if it in turn were likewise open. The following cases are, therefore, of interest mostly from the scientific standpoint. The host was *Cynomyia cadaverina* in the stage just preceding the final eclosion, though this fact was unknown when the hosts were exposed to the parasites in confinement in order to insure a second generation. The parasites were those from hibernated larvae, or parents of the first generation. The host puparia were formed on April 23, and were thus six or more days old.

Case I. Three virgin females of the parasite emerging at 1:30 P. M., April 29, 1909, were at once confined separately in vials, each with four of the host puparia. Oviposition was not observed. The hosts were then six days old; by 9 A. M., May 1, eight of the host puparia had excluded adults which were at once released; another adult excluded at 11:20 A. M., May 1st, and two more at 8:30 A. M., May 2d; the single remaining puparium was apparently successfully parasitized by one of the females but upon examination on May 15, 1909, no traces of parasites could be found.

Case II. A pair of adults of the parasite which had mated for the first time at 9:45 A. M., April 29, were confined in a vial with eight of the host puparia; the female noticed the hosts at once but left them and was engaged with the male for a short while. During the afternoon, however, she commenced to deposit eggs; at 10:08 P. M., April 30, a host fly emerged and again at 10:25 P. M., the same day, when the mother parasite was engaged in depositing into another host. At 9 A. M., and 7 and 9 P. M., May 1, three host flies emerged, and again on May 2, at 11 A. M., and 5 P. M. The remaining host was

successfully parasitized, it having been partly opened at 3 P. M., May 13 and found to contain larval parasites. In this case the parasite was successful up to within about 24 hours of the final ecdysis, the host pupa being perfect and with all the colors of the mature adult.

Case III. At 11:20 A. M., April 29, nine males and twenty females of the parasite, which had been freely mating, were confined together under a bell-jar with ten of the host puparia; oviposition was observed at noon and was continued with persistence until noon, May 3, when the observations had to be discontinued. During this time none of the hosts emerged, though in a control lot, emergence became general early on May 1, beginning during the morning of April 30. Hence in this case, the parasites being in greater numbers, not a single host escaped.

Summarizing, parasitism by *Nasonia* is "effective" or successful in many cases almost up to within the few hours immediately preceding the final ecdysis, depending on circumstances; a single female parasite, for example, would be able to kill a single host puparium up to within about 15 hours of eclosion, but where a number were present, many would escape before she would be able to deposit into them. And the converse is true. The host when thus attacked is a perfect pupa and fully colored.

O. *Length of Life in Confinement; Adults.*

The adults of this parasite lived for about five days on the average in confinement, the males dying somewhat earlier. They were unfed in all cases.

P. *Change in Coloration of the Pupa.* When first formed the pupae are yellowish white, the eyes garnet, with some duskiness at the caudal edges of the abdominal segments soon afterwards; the mandibles, legs, antennae and wing-pads gradually become dusky and about 48 hours previous to eclosion, the head, thorax and abdomen, in succession, begin to show dark color, the head and thorax together becoming a deep black before the abdomen shows very much color, and then after about 6 hours, the latter turns gradually but rapidly black. About 20 hours before eclosion, the color is jet black, which just preceding emergence changes nearly to the colors of the mature adult. At eclosion, the adults are fully colored.

LITERATURE REFERRED TO.

1878. Thomson, C. G. Hymenoptera Scandinaviae, Lundae, V, pl., fig. 18.
1896. Ashmead, William H., Descriptions of new Parasitic Hymenoptera. Trans. American Ent. Soc., XXIII, p. 221.
1904. Ashmead, William H., Classification of the Chalcid flies or the Superfamily Chalcidoidea. Mem. Carnegie Mus., Pittsburgh, I. (Publications of the Carnegie Museum, Serial No. 21.) pp. xi, 317–318.
1906. Nason, William A., Parasitic Hymenoptera of Algonquin, Illinois.—IV. Entomological News, Philadelphia, May, XVII, p. 221.

The Harris Memorial Tablet.

On Friday, December 31, the final day of the recent entomological meetings in Boston, delegates from the various Societies represented in those meetings went out to Milton village, and with brief ceremony unveiled a simple marble tablet placed on the old "Suffolk Resolves mansion" to commemorate the residence there of Thaddeus William Harris.[1]

The inscription, composed by Colonel Thomas Wentworth Higginson, who in his student days was a pupil of Harris, reads as follows:

IN THIS HOUSE FROM 1824 TO 1831 DWELT
THADDEUS WILLIAM HARRIS M. D.
BOTANIST, ENTOMOLOGIST; AND FINALLY
LIBRARIAN OF HARVARD COLLEGE

IN EACH CAPACITY HE WON
FOR HIMSELF FAME AND GRATITUDE

HE HAD THE MODESTY AND UNSELFISHNESS
OF TRUE SCIENCE
WITH WHAT MAY RIGHTLY BE CALLED
ITS CHIVALRY OF SPIRIT

Besides the entomologists, there were present representatives of the Milton Historical Society and the Science Club of Milton Academy.

W. L. W. Field.

[1] See Psyche, Vol. xiv. p. 67, August, 1907.

NOTES ON HEMILEUCA LUCINA HY. EDW.[1]

By William Reiff.

On the 19th of last June, while in the company of Dr. Arthur L. Reagh on a collecting trip to the neighborhood of Raymond, N. H., we came upon a swampy meadow where there was an abundance of Meadow-sweet (*Spiraea salicifolia L.*). Immediately my attention was attracted to these plants which harbored a large number of unknown caterpillars. Interested in the find, we looked further and found the same species on nearly every bush of the *Spiraea*. The caterpillars were partly in the second and partly in the third stage, feeding close together in large numbers and dropping to the ground upon being disturbed. They were so thickly distributed on the plants, that often entire twigs were covered with the larvae, giving the impression of strong swellings upon the twigs. According to our estimates, we must have seen more than 20,000 caterpillars in the locality, but owing to lack of proper receptacles, we could unfortunately collect only a small part for breeding.

Although the caterpillars resembled those of *Hemileuca maia* Drury very closely, we could not satisfy ourselves that they belonged to this species, for it seemed strange that all the *maia* females should have laid their eggs on meadow-sweet when there was close by an abundance of oak which is the favorite food of *maia*. We also searched the nearby oaks for *Hemileuca* caterpillars without result, but Dr. Reagh found some *maia* on oaks several miles further on which proved their presence in the locality. Our caterpillars could therefore hardly be *maia*, for this species would have no necessity of laying its eggs on plants other than oaks. As already mentioned, our caterpillars were very similar to those of *maia*, and like them were black in the youngest stage, but distinguishable by a strong brilliancy, best compared to black stove-polish. The appearance of the older caterpillars was exactly like that of *maia*, except that all had a sharply defined white stripe above the feet, which is absent or faint in *maia*. In spite of plentiful and regular feeding the size of the growing caterpillars remained always less than that of *maia*. Pupation occurred on the

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 13.

surface of the ground under dry leaves, without the preparation of any sort of a cocoon. The cremaster of the pupa is composed of about twenty-five strong brown spines with curved apices (see figure). In other respects, the form and color of the pupa are the same as those of *maia*; the size of *lucina*, however, always remains less. The first moths emerged from their pupae on the 2nd of September, and proved to be two males of *Hemileuca lucina* Hy. Edw. The first females emerged on the 4th of September, and the period of emergence extended almost through the entire month, the last adults appearing on September 28. In all sixty-three moths were obtained, in the proportion of 2 : 1.3 or about twice as many males as females. No parasites were obtained although six pupae died.

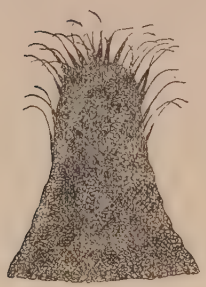


Fig. 1. Cremaster of *Hemileuca lucina* Hy. Edw.

Henry Edwards states in his description of the form *lucina* (Entomologica Americana, Vol. II, No. 1, p. 14, April 1886) that the white band which encloses the discal spot is of equal width across the entire wing. This is not the case, however, as this character is the one which shows the greatest range of variation. I have before me a large number of specimens in which the discal spot is bordered with white only near the fore and hind margins, the white being so much reduced in size that it is divided into two parts by the spot. The most extreme form, of which I have one male and one female specimen, has the white band wedge-shaped and pointed toward the discal spot, above which it shows only as a slight light shadow. Since such extremes of variation in the direction of aberrations undoubtedly deserve names, I propose the name *ab. obsoleta* for this form of *H. lucina* with the following diagnosis:

Ab. **obsoleta** *m.: alis ant. fascia candida plus minusve obsoleta.* Types 1 ♂, 1 ♀, in the collection of the Bussey Institution.

The white band varies in another direction also, and both on the fore as well as on the hind wings. The white band may become cream yellow for its entire extent, the black ground color becoming at the same time changed to a gray, perhaps through some albinistic

tendency. The most typical specimens of this aberration are females, as all the males of this form which I have seen show transitions to the type. I propose the name *ab. lutea* for this yellow form with the following diagnosis:

Ab. **lutea** *m.: alis ant. et post. grisescentibus, fascia lutea nec candida.* Types, two ♂♂ (transitions), two ♀♀, in the collection of the Bussey Institution.

There is also a noteworthy male specimen, which has extraordinarily strongly developed veins, which are of a blackish green-brown color. The veins are irregularly marked with small greenish-brown specks along their entire extent. I am inclined to believe that the pupa from which this specimen developed was supplied with too great a quantity of lymph which enlarged the veins abnormally at the time of emergence, and later penetrated in the form of minute drops through the vein to the surface of the wing.

I treated a small percentage of the fresh pupae (10 specimens) with cold, exposing them to a temperature of –3° C. for seven consecutive days. From these seven moths emerged, three of the pupae dying. Of the emerging moths (6 ♂♂, 1 ♀) the wings of two males did not expand, but the others developed to the normal size. One male was a typical *ab. obsoleta,* the female was the typical *ab. lutea.* The color pattern of the other three males were normal, except that all had the black ground color somewhat lighter than specimens coming from unexposed pupae.

As to the systematic position of *H. lucina,* I cannot but believe that it is a distinct species, and not a subspecies of *H. maia.* The points which would support this position are as follows:

1. There are differences in the caterpillars and pupae of *H. maia* and *H. lucina.*
2. No transitions between *H. maia* and *H. lucina* have been made known.
3. The food plant of *H. maia* (Oak) and of *H. lucina* (Meadow-sweet) are fundamentally different.
4. The habits of the young caterpillars are different. Those of *lucina* are gregarious, forming large clumps on the twigs of the food plant, while those of *maia* sit next to one another, in rows across the leaves.
5. *Maia* pupates under normal conditions in the ground, while *lucina* pupates between dried leaves.

6. I am unable to account for the occurrence at the same place of *H. maia* as typical form with a strongly marked local form. If *maia* and *lucina* are really so closely related, we should expect crosses to take place in nature, especially as when *maia* males first emerge, only females of *lucina* are present, since the flying period of the two species overlaps only in the latter part of September. So far, however, no specimen has been found, which could be a cross between the two, that is to say, one which shows characters of both, for the individuals of both forms are always easily separated from one another. Henry Edwards has already mentioned in his description of *H. lucina* (l. c.) as a very noteworthy fact that all the specimens of *maia* which had come under his observation were readily known as such in spite of their considerable variability, while he was always able quickly to distinguish them from *lucina*.

The species and aberrations of *Hemileuca* occurring in the New England States would therefore be the following:

Hemileuca maia, Drury.
Hemileuca lucina Hy. Edwards.
ab. obsoleta Reiff.
ab. lutea Reiff.

A PECULIAR TYPE OF PHORIDAE FROM NATAL.[1]

By Charles T. Brues.

Until within the last decade, the Phoridae of the Ethiopian region were practically unknown, but during this short period considerable interest in the group has developed among a number of entomologists, and many African forms have been described. Most of these belong to extraordinary apterous types, although several of the less specialized genera have been found in widely scattered parts of the continent. These few discoveries have shown the extreme interest attaching to the Phorid fauna of this region, and I have endeavored to include them in the present short summary, together with the description of an interesting new genus from Natal recently sent to me by Mr. Ernest E. Austen of the British Museum.

Twelve genera are now known to be represented in the Ethiopian region, several of them very closely allied, and probably not actually generically distinct, but all are included in the following table.

Key to the Ethiopian Genera of Phoridae.

1. Wings fully developed....2
   Wings much reduced in size and venation, or entirely absent....5
2. Third vein in wing furcate near the tip....**Aphiochaeta.**
   Third vein simple, not furcate....3
3. Head of normal form, with sloping front....4
   Head produced and squarely truncate above the antennae, forming a frontal shield....**Coryptilomyia.**
4. Anterior frontal setae proclinate, hind tibiae with distinct spurs **Puliciphora,** male.
   Anterior frontal setae absent, hind tibial spurs minute; wings more hairy than usual....**Chonocephalus,** male.
5. Abdomen of normal form, species often cockroach-like, apical segments terminal in position....7
   Abdomen greatly swollen, the last segments very small and directed forward under the basal ones....6
6. Antennal arista pubescent....**Termitoxenia.**
   Antennal arista loosely plumose....**Termitomyia.**
7. Wings of considerable size, though much atrophied; no ocelli; proboscis long, geniculate....**Psyllomyia.**
   Wings very small or entirely absent; proboscis short or wanting....8

[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 15.

8. Abdomen with distinct segments, indicated by 4–6 dorsal plates or by evident constrictions.....10
   Abdomen with all the segments fused into a single plate or into two....9
9. Abdomen with two segments, the first short, the second long. **Thaumatoxena.**
   Abdomen entirely unsegmented.....**Termitodeipnus.**
10. Ocelli absent.....11
    Ocelli present.....**Puliciphora.**
11. Abdomen entirely membranous.....**Wandolleckia.**
    Abdomen with chitinous plates.....12
12. Body flattened, oval, cockroach-like.....**Aenigmatistes.**
    Body more convex, with the usual tripartite form.....13
13. Dorsal abdominal plates wide, crossing the entire width of the abdomen. **Chonocephalus.**
    Dorsal plates much reduced in width.....**Cryptopteromyia.**

Coryptilomyia gen. nov.

Female. Wings fully developed; costa long, weakly ciliate; third vein simple, bare, neither furcate nor swollen at the apex; first vein long; fourth vein curved parallel to the costa, ending at the wing-tip after a course much nearer the costa than usual; 5th to 7th veins distinct, complete. Head with the vertex prolonged in front, then sharply declivous on the front which bears a raised margin above, giving the front of the head a truncate, shield-shaped appearance. Front without bristles except for an occipital row of four and a similar series of much more delicate ones just anterior to these. Antennae subovate, with dorsal arista. Palpi short, scarcely bristly; proboscis very short, almost rudimentary. Body very robust, the mesonotum broad; scutellum strongly transverse, nearly four times as broad as long. One pair of dorsocentral macrochaetae and six scutellar bristles in addition to one close to each lateral angle on the mesonotum. Legs rather slender, tibiae without macrochaetae, hind ones delicately setulose.

Coryptilomyia armigera sp. nov.

Female. Length 3 mm. Yellowish brown or tinged with castaneous; pleurae and legs fuscous or piceous; abdomen almost entirely piceous, sometimes yellowish medially at the base, the segments with narrow whitish margins. Antennae and palpi bright orange yellow. Head seen from the side less than twice as high as thick, sharp above then concave and sloping down to the upper edge of the frontal shield from which it falls off perpendicularly to the antennal cavities. Eyes large, bare, narrowly oval. Antennae rather large, ovate, with a nearly bare arista as long as the head height. Palpi short and stout, with very delicate bristles below. Ocelli large, ranged in a curved row and well separated. Viewed from the front, the head is about twice as broad as high, the margin of the frontal shield above almost semi-circular in outline, the margin below truncate medially and scalloped out on each side to

conform with the large antennal cavities. Post-ocular cilia very minute. Mesonotum large and broad, considerably wider than the head; at its humeral angles the propleurae extend far inward, so as to be visible from above as large triangular sclerites, each with the prothoracic spiracle near its center. Lateral margins of mesonotum with a fringe of stiff hairs. Mesopleura below the root of the wing with three macrochaetae. Abdomen of the usual form, with none of the segments elongated except the sixth. Legs long and quite slender, the anterior tibiæ entirely bare, each with a microscopic apical spur; middle ones with a fringe of very fine setulae; hind ones with a row of rather strong

Coryptilomyia armigera sp. nov. Female.

A. Wing; *B*. Side view of head; *C*. Front view of head.

setulae along the dorsal edge, and a second one along the outer side; all four posterior tibiae with distinct spurs. Wings of ample size, hyaline with fuscous veins; the costal vein reaching to the middle, its cilia very short; tip of first vein twice as far from the humeral cross-vein as from the tip of the third; fourth vein running nearly parallel to the wing margin, forming a very narrow cell and ending barely before the wing tip; fifth sinuous, curving forward on its apical half; sixth nearly straight; seventh curved, close to the wing margin. Halteres dark brown.

Two specimens from Durban, Natal, South Africa, 1909. (B. Marley.) Type in the British Museum of Natural History.

Phora cochlearipalpus Speiser.

Berliner entom. Zeitschr., 52, p. 146. (1908.) Amani, German East Africa.

Aphiochaeta braunsi Brues.
Entomological News, 1907, p. 391. Cape Colony.

Aphiochaeta xanthina Speiser.
Berliner entom. Zeitschr., 52, p. 148. (1908.) Kamerun.

Psyllomyia testacea Loew.
Wiener entom. Monatsschr., 1, p. 54. (1857.) Cape Colony.

Puliciphora africana Brues.
Ann. Mus. Nat. Hungarici, 5, p. 410. (1907.) German East Africa.

Chonocephalus kiboshoensis Brues.
Ann. Mus. Nat. Hungarici, 5, p. 410. (1907.) German East Africa.

Wandolleckia cooki Brues.
Trans. American Entom. Soc., 29, p. 392. (1904.) Liberia.

Wandolleckia indomita Brues.
Ann. Mus. Nat. Hungarici, 5, p. 412. (1907.) German East Africa.

Cryptopteromyia jeanssoni Trägårdh.
Zool. Jahrb. Atbh. f. Syst., 28, p. 229. (1909.) Natal.

Aenigmatistes africanus Shelford.
Journ. Linn. Soc. London, Zool., 30, p. 151. (1908.) Victoria Nyanza.

Thaumatoxena wasmanni Breddin & Börner.
SB. Gesellsch. naturf. Freunde Berlin, 1904, p. 87. Natal.

Termitodeipnus andreinii Silvestri.
Redia, 3, p. 356. (1906.) Eritrea.

Termitoxenia havilandi Wasmann.
Zeitschr. wiss. Zool., 67, p. 601. (1901.) Natal.

Termitoxenia jaegerskioeldi Wasmann.
Results Swedish Exped. Egypt & White Nile, 13, p. 16. (1904.) Uganda.

Termitomyia braunsi Wasmann.
Zeitschr, wiss. Zool., 67, p. 611. (1901.) Orange Free State.

Termitomyia mirabilis Wasmann.
Zeitschr. wiss. Zool., 67, p. 610. (1901.) Natal.

Phora camariana Coquerel.
Ann. Soc. Ent. France, 6, p. 189. (1848.) Madagascar. This is not recognizable from the description and may quite probably not belong to this genus.

RECENT LITERATURE.

INDIAN INSECT LIFE. By H. Maxwell-Lefroy, Entomologist, Imperial Department of Agriculture for India, Assisted by F. M. Howlett. Thacker, Spink & Co., Calcutta & Simla. 1909.

Although this book was primarily intended for the struggling student of entomology in India, it contains much of interest and value to workers throughout the World and American entomologists will find it worthy of a careful reading. Nearly 800 pages, 84 plates principally in color, and 536 figures compose the volume of goodly royal octavo size which is very well printed.

The subject matter treats specifically of the insects of the "Plains" or tropical India, an area embracing all the southern part of India except on mountains rising above 2000 feet, which contour line also limits it on the north in the foot-hills of the Himalayas from subtropical India which is not dealt with in the present work. It appears that insects are much less numerous in tropical than in subtropical India, due to the absence of the moist forested slopes and varied types of vegetation which occur on the hills of the latter.

Throughout the volume special stress is laid upon economically important insects many of which are close counterparts of related species known to western entomologists and numerous species are discussed which will quite probably enter our own country in the future. Among these are particularly various forms destructive to rice, cotton, corn, cane, tea, etc. A very commendable feature is the illustration of the complete life history of many species.

Interspersed among the systematic enumeration of families with their more prominent Indian representatives, are short discussions of topics of more general biological interest, making on the whole a very readable book in spite of its large size and necessarily taxonomic character. The author is certainly to be admired by his more fortunate American co-workers for having presented in very well arranged form a summary of the entomology of a country like India where the entomologist must still be a pioneer in his chosen field.

C. T. B.

FIFTH MEETING OF THE ENTOMOLOGICAL SOCIETY OF AMERICA.

The Fifth Meeting of the Entomological Society of America was held at the Harvard Medical School, Boston, Dec. 30th and 31st, 1909. The President, Dr. Henry Skinner, presided throughout the sessions. The President announced the deaths of William H. Edwards, an Honorary Fellow, Prof. Mark Vernon Slingerland, a Fellow, B. H. Guilbeau, W. Brodie and H. M. S. Seib, Members. Suitable resolutions on the deaths of Mr. Edwards and Professor Slingerland were adopted. The Report of the Executive Committee showed among other things that 16 new members had been received during the year and 22 memberships had terminated, not including those who had died. Also that a memorial drawn up by Mr. N. C. Wood regarding the tariff on insects and signed by the President and Secretary had been productive of no action by Congress.

The question of appointing delegates to the approaching International Congress of Entomology was referred to the Executive Committee.

The following officers were elected:

President, Dr. John B. Smith.
First Vice-Pres., Dr. S. A. Forbes.
Second Vice-Pres., Prof. V. L. Kellogg.
Secretary-Treasurer, Mr. C. R. Crosby.

Additional Members of the Executive Committee.

Prof. J. H. Comstock
Prof. W. M. Wheeler
Mr. E. A. Schwarz
Prof. J. M. Aldrich
Rev. Prof. C. J. S. Bethune
Prof. Lawrence Bruner.

Member of the Committee on Nomenclature.

Prof. T. D. A. Cockerell (to succeed himself).

The Report of the Committee on Nomenclature concerning the nomenclature of Gall Insects read at the Baltimore meeting, and printed in the Annals for 1909, was adopted as printed, with the provision that the Society express itself as standing with the majority of the Committee in Section V.

Mr. Brues suggested that Professor Felt submit a list of names of Gall Insects that he thought could be accepted as standard.

Moved and carried that the request of Dr. Stiles published in Science, for the preparation of a list of one hundred important names to be adopted by the Congress of Zoology as standard, be referred to the Executive Committee.

The following amendment to the Constitution was adopted:

Article V., Sec. 3. Election of officers. All officers shall be elected by ballot at the annual meeting for the term of one year and shall be eligible for re-election. Their term of office shall commence with the first of June following their election.

The Secretary was instructed to take a mail vote of all members and fellows of the Society as to whether the present arrangement of paying separate dues and subscriptions to the Annals should be continued, or a single membership fee of two dollars be charged, and members receive without further expense the publications of the Society.

Professor Sanderson suggested the adoption of a uniform style of button for both the entomological societies meeting in affiliation with the American Association for the Advancement of Science. Referred to the officers.

The following papers were read during the sessions:

R. Matheson. Remarks on the External Anatomy of the Haliplidae.

W. M. Wheeler. On the Effects of Parasitic and Other Kinds of Castration in Insects.

A. H. Morgan. Some Correlations of May-fly Structure and Habits.

C. R. Crosby. Some Observations by the Late Professor Slingerland and the Speaker on the Life History of *Heterocordylus malinus* (Read by title.)

C. J. Triggerson. The Life-cycle of the Oak Hedge-hog Gall-fly (*Acraspis erinacea*).

F. L. Washburn. A Jumping Seed-gall on the Burr Oak.

A. D. MacGillivray. The Female Reproductive Organs of *Corydalis cornuta.*

W. L. W. Field. The Offspring of a Captured Female of *Basilarchia proserpina.*

H. H. Lyman. An Improved Drawer for Insect Cabinets and a New Substance for Lining them.

C. T. Brues. Some Notes on the Geological History of the Parasitic Hymenoptera.

J. C. Bradley. The Plaiting of the Wings of Hymenoptera.

T. J. Headlee. An Apparatus for the Determination of Optimums of Temperature and Moisture for Insects.

A. D. MacGillivray. The Radial Sector in *Phlebatrophia mathesoni*.

W. T. M. Forbes. A Structural Study of some Caterpillars.

M. J. Elrod. The Blackfoot Glacier as an Entomological Burying Place. (Read by title only.)

J. J. Davis. *Chaitophorus populifoliae* Fitch versus *Chaitophorus populifoliae* Oestland. (Read by title only.)

L. Haseman. The Life History of a Species of Psychodidae. (Read by title only.)

A. G. Hammar. Notes on the Life history of *Fidiobia flavipes* Ashmead, an Egg Parasite of the Grape Root Worm (*Fidia viticida* Walsh).

A very interesting and extensive exhibition was held in conjunction with and under the auspices of the Cambridge Entomological Club in rooms adjoining the meeting hall.

The Annual Public Address was given by Dr. John B. Smith on the evening of December 30 in the hall of the Boston Society of Natural History, title: "Insects and Entomologists: Their relations to the Community at Large."

On Tuesday evening the visiting entomologists were the guests of the Cambridge Entomological Club at a most enjoyable smoker held in Copley Hall.

J. Chester Bradley,
Secretary-Treasurer.